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Status of Atlantic Salmon (*Salmo salar* L.) Populations in Crabbes and Robinsons Rivers, and Middle Barachois, Fischells and Flat Bay Brooks, Newfoundland, 2000

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Abstract

Adult Atlantic salmon were visually counted in Middle Barachois Brook 1-3 August, and Crabbes River, Robinsons River, Fischells Brook, and Flat Bay Brook, 14-23 August 2000. The surveys were conducted by crews of 2 to 13 snorkellers floating down the main stem of each river. Salmon were predominately concentrated in pools with water depths less than 1m. An adjustment factor, ranging from 1.0 to 2.0 was applied to the counts in each river section to account for fish not observed. There were no known removals after the survey, therefore the adjusted count is considered to be the spawning escapement for the river. The salmon retained by anglers and 10% of the hooked-and-released salmon were added to the adjusted spawner counts to approximate the total returns to each river. The estimated total numbers of salmon that returned to each river are: Crabbes River, 1026 small and 155 large salmon; Middle Barachois Brook, 1142 small and 155 large salmon; Robinsons River, 1425 small and 322 large salmon; Fischells Brook, 1800 small and 276 large salmon: and, Flat Bay Brook, 2308 small and 477 large salmon. The percentage of the egg deposition conservation requirements achieved were 63% for Crabbes River, 95% for Middle Barachois Brook, 135% for Robinsons River, 142% for Fischells Brook, and 167% for Flat Bay Brook. The egg deposition is higher in 2000 than in 1999 for all rivers except Crabbes River. The information available did not lend itself to forecasting the abundance of salmon in 2001. Two rainbow trout were observed in Crabbes River. The origin of these rainbow trout is unknown.

Résumé

Des dénombrements visuels des saumons atlantiques adultes ont été effectués du 1er au 3 août 2000 dans le ruisseau Middle Barachois, et, du 14 au 23 août 2000, dans les rivières Crabbes et Robinsons, ainsi que les ruisseaux Fischells et Flat Bay, par des équipes de 2 à 13 plongeurs en apnée qui se laissaient flotter dans le cours principal de chaque rivière. Les saumons se concentraient surtout dans des fosses de profondeur inférieure à un mètre. Le nombre de saumons observés dans chaque tronçon a été corrigé par un facteur variant entre 1,0 et 2,0 pour tenir compte des poissons qui n'ont pas été aperçus. Comme il n'y a eu aucun prélèvement connu de poissons après le relevé, les dénombrements corrigés sont considérés comme représentatifs de l'échappée des géniteurs. Le nombre de saumons conservés par les pêcheurs et 10 % des saumons capturés puis remis à l'eau ont été ajoutés aux dénombrements corrigés de géniteurs pour estimer la remonte totale. Voici les estimations de la remonte totale dans chaque cours d'eau : 1026 petits et 155 grands saumons dans la rivière Crabbes; 1142 petits et 155 grands saumons dans le ruisseau Middle Barachois; 1425 petits et 322 grands saumons dans la rivière Robinsons; 1800 petits et 276 grands saumons dans le ruisseau Fischells; 2308 petits et 477 grands saumons dans le ruisseau Flat Bay. Les pourcentages de la ponte nécessaire à la conservation atteints dans chaque cours d'eau sont les suivants : 63 % dans la rivière Crabbes, 95 % dans le ruisseau Middle Barachois, 135 % dans la rivière Robinsons, 142 % dans le ruisseau Fischells et 167 % dans le ruisseau Flat Bay. Dans tous les cours d'eau excepté la rivière Crabbes, la ponte a été plus élevée en 2000 qu'en 1999. Les données disponibles ne se prêtaient pas à la prédiction de l'abondance du saumon en 2001. Deux truites arc-en-ciel d'origine inconnue ont été observées dans la rivière Crabbes.

Introduction

Atlantic salmon populations in Bay St. George rivers declined in the 1970's (Porter and Chadwick 1983) and have been below conservation levels for most of the past 30 years (Reddin and Mullins, 1996). The total returns to rivers appear to have only marginally increased with the closure of the commercial fisheries in 1992. Direct measurements of salmon population sizes in most rivers are difficult to obtain using conventional fish counting facilities due to the large size of the rivers and their extreme range in discharge.

Reddin and Mullins (1996) conducted assessments of the salmon populations in rivers in Bay St. George, used angling catch statistics and estimates of angling exploitation rates to estimate population sizes. Snorkelling surveys have been used to estimate the numbers of large and small salmon spawners in several rivers in Bay St. George since 1996 (Bourgeois et al. 1997; Porter 1997, 1999, and 2000a; and Porter and Bourgeois 1998). These surveys indicated generally higher populations of salmon in recent years than in the late 1980's and early 1990's. The salmon populations in Robinson's River and Flat Bay Brook appear to be in better condition relative to their threshold conservation egg deposition requirements than Crabbes River, Middle Barachois, and Fischells brooks.

Snorkelling surveys were again conducted in year 2000, to obtain estimates of small and large salmon in Crabbes and Robinsons rivers, and Middle Barachois, Fischells and Flat Bay brooks (Figs 1-5). This document is an assessment of the status of the salmon populations in these rivers. The physical characteristics of these five rivers are described in Table 1.

Fisheries Management Measures

In 1978, restrictions were placed on the commercial and recreational fisheries in response to a decline in returns of salmon to Bay St. George rivers (Chadwick et al 1978). Further reductions were placed on the commercial fisheries in the 1980's, and it was eventually closed in 1992. The retention of large salmon has been prohibited since 1984. The changes in the seasons and quotas in the recreational fisheries since 1953 are shown in Table 2. In 1992 and 1993 there were Salmon Fishing Area (SFA) quotas for the recreational fisheries, but the quota for SFA 13, which includes Bay St. George was only reached in 1992. Flat Bay Brook was closed to all angling in 1995 and 1996, and Fischells Brook was closed in 1999 and 2000. Due to high water temperatures and low water levels in 2000, Crabbes River, Middle Barachois Brook, Robinsons River, and Flat Bay Brook were closed to angling August 3-11.

Methods

Recreational Fisheries data

Angling data were available from the salmon angler licence stub in 2000 (see O'Connell *et al.*1998 for a description of the methodology). The angling data for 1999 was updated.

Unrecorded mortalities

An estimate of all fish killed or naturally died before spawning is important for any stock assessment. Illegal activities do occur on the rivers being assessed; however, no quantitative estimates of salmon mortality are available. The percentage of salmon that will die due to being hooked and released by anglers will vary with handling techniques and water temperature (Anon 1998; Dempson et al *In press;* Wilkie et al., 1996; and Brobbel et al, 1996). Mortality of hooked-and-released salmon at water temperatures below 20° C is expected to be less than 10%, if fish are handled properly. This value was applied to the estimated number of salmon released for the five rivers assessed.

Biological characteristics

The biological characteristics that are most important for assessing the status of an Atlantic salmon population are: proportion of large (≥ 63 cm) and small (<63) salmon, mean weight or length and percent female of each size group, and relative fecundity. The values of these parameters determine the reproductive potential of the stock.

For Crabbes and Robinsons rivers and Fischells Brook, the mean weights (1.63 kg for small, 5.06 kg for large) and percentage female (71.9% for small, 86.8% for large salmon) used in this assessment are values for years 1992-94 from Table 6a & b in Reddin and Mullins (1996) (Table 3). The mean weight, mean length and percent female for the salmon population in Middle Barachois Brook are those obtained from 34 large salmon and 71 small salmon seined in Section 1, Middle Barachois Brook, in August, 1998 (Porter 2000a). The estimated mean fecundity of 1540 eggs/kg of body weight used by Porter & Chadwick (1983) was also used for Crabbes and Robinsons rivers, and Fischells and Middle Barachois brooks. The percentage of large and small salmon in each population used in this assessment is the percentage observed in the survey in 2000.

For Flat Bay Brook, biological characteristics data were available for fish taken as broodstock in 1994-96 and from the angling fishery in 1994 (Table 3) (Bourgeois et al. 1997). These values were used in this assessment except for percent female for small salmon, which was taken from Reddin and Mullins (1996). A length-fecundity relationship for salmon in Flat Bay Brook was developed from samples taken as broodstock in 1995 and 1996 (Porter and Bourgeois 1998).

Conservation spawning requirements

Spawning requirements for Atlantic salmon represent an estimate of the number of eggs (or spawners) required for conservation of the stock (O'Connell & Dempson 1995). Juvenile salmon rear in both fluvial and lacustrine habitat and thus spawning requirements are based on the number of eggs required for both types of habitat (O'Connell & Dempson 1995). The habitat accessible to sea-run salmon in Crabbes and Robinsons rivers, and Middle Barachois, Fischells and Flat Bay brooks is primarily fluvial with little lacustrine habitat (Table 1). Therefore, in relation to the fluvial habitat, the production of parr in lacustrine habitat would be small but still important.

Conservation egg deposition requirements for the five rivers being assessed are those calculated by Reddin & Mullins (1996) as target eggs.

The conservation requirements in terms of numbers of spawners requires knowledge of the proportion of the conservation egg deposition level that should come from large salmon and from small salmon. Since these rivers are believed to historically have had a significant component of virgin 2SW salmon, it is uncertain how to determine the appropriate number of large salmon that should be in the spawning population to meet its conservation requirements. The populations are currently at low levels; thus, the observed proportions of large and small salmon may not be the appropriate composition for conservation of the large salmon component. Estimate of the large and small salmon conservation requirements were calculated by Porter and Bourgeois (1998) but were not recommended for use as minimum threshold limits for fisheries management due to the above mentioned uncertainties.

Survey Methodology

In 2000, Atlantic salmon were visually counted in Middle Barachois Brook 1-3 August, in Crabbes River 14-16 August, in Robinsons River 16-17, and 23 August, in Fischells Brook 19-20 August, and in Flat Bay Brook 20-22 August. The counts were conducted by surveyors who snorkelled down sections of the main stem of each river that were believed to be accessible to anadromous salmon, with the exception of Sections 1 and 2 of Flat Bay Brook, which could not be surveyed due to high water. The water levels were sufficiently low on Crabbes River that the gorge (Section 2) could be surveyed for the first time. Also, modifications to the survey procedures enable the large pool at the base of the falls on Robinsons River to be surveyed for the first time. No tributaries of either river were surveyed. The tributaries are small and water levels were low during the time of the surveys. Salmon generally enter these small tributaries later in the year when water discharges increase. Few salmon were observed in the tributaries during surveys in previous years. Water levels in Middle Barachois Brook and Sections 1-3 of Crabbes River were low when surveyed. Water levels were moderately low for the other survey areas except for Flat Bay Brook, which had moderately high water levels.

The main stem of each river was divided into four (4) or five (5) sections with each section generally being less than 10 km in length (Figs 1-5). The procedures used in conducting the surveys in 2000 were similar to those previously reported by Porter (1999 and 2000a) and Porter and Bourgeois (1998) with the following modifications:

1) The main stem of each river was divided into cells that corresponded to the 1km grids on 1:50,000 topographic maps. Each grid cell traversed by the river was given a cell number beginning with #1 in the estuary. The cell number in which salmon were observed during the survey was recorded for future reference.
2) Section 1 of Fischells Brook was surveyed using a helicopter to ferry the crew between pools. This Section contains only a few pools, and in previous years, very few salmon were observed outside these pools.
3) The pool at the base of the falls, Section 1 Robinsons River, is about 200 m in length and 5-30 m wide. There are steep cliffs on both sides that go straight down into the water. The water in

most of the pool is too deep for a snorkeller to see the bottom. Ten snorkellers were used to survey the pool. A rope was strung across the river and at 2.5m intervals a 4m-long yellow rope was attached. A rock was attached to the free end of the 4m rope and suspended in the water column. Snorkellers lined up across the horizontal rope at equal intervals and floated down river. In shallow water snorkellers, kept the suspended rocks off the bottom. This technique herded the salmon to shallower (<3m) in the downstream end of the pool; where, they were counted as they swam upstream under the rope.

4) The gorge, Crabbes River Section 2, was surveyed with two snorkellers. Initially, each snorkeller worn a body harness with a safety rope being held by an assistant at the top of the gorge. This type of safety rope was found to be unsuitable because the assistants could not easily walk along the top of the gorge while holding the rope due to debris, trees and large crevices and the safety rope would get caught in rock out-crops. Thus, this technique was abandoned, and the snorkellers held a safety rope between them, using a "buddy system" to ensure no one accidentally went over any rapids or small falls. In most sections of the gorge the water velocity was sufficiently low that the snorkellers could hold position without assistance. Throughout most of the gorge, one snorkeller could see the entire cross-section of the river.

A survey crew, comprising of snorkellers and recorders, was assigned to each river Section. Crews varied in size from three (3) to 17 people, with a minimum of two (2) and a maximum of 13 snorkellers per crew. The snorkellers would passively float or swim downstream and count salmon; and, one or two recorders would walk along the riverbank and record the information. A rope was frequently stretched across the river and held in place by two recorders, or snorkellers. The snorkellers would line up across the river along the rope such that there was total underwater horizontal visual coverage. The recorders would slowly walk down river with the snorkellers holding onto the rope. Snorkellers would all look underwater in the same direction across the river and count the salmon that passed between himself/herself and the adjacent surveyor. This technique proved to be very effective and greatly increased the confidence in the estimates of the number of fish in the larger pools. If snorkellers were unsure of the count, they would float through the pool a second or third time. When two or more passes were made through the same pool, the highest count was recorded except in circumstances where the numbers of fish were estimated, in which case the average was recorded. Water depths in many riffle areas were too shallow for swimming, particularly in the upper sections (Sections 1 and 2) of each river. Adult salmon are infrequently found in shallow water at this time of the year.

In each Section, surveyors consecutively numbered pools where salmon were observed. When salmon were observed the pool number and the appropriate map cell number were recorded in a field notebook along with the number of large and small salmon, number of salmon with net marks or other injuries, and a description of the pool.

Number of Spawners and Total Returns to Rivers

Raw data collected during previous surveys were reviewed and revealed some minor discrepancies in the number of salmon observed in Crabbes River in 1998 and in 1999, and Robinsons River in 1999 compared to that reported in Porter (1999 and 2000a). The estimates for numbers of spawners, total returns and percent of the conservation egg deposition requirements that were achieved, were up-dated for these rivers and years.

An adjustment factor was applied to the number of salmon counted in each river Section to account for unobserved salmon. Some of the pools were too deep or too wide to obtain a complete count of salmon and in some sections visibility was reduced. Also, there may have been small numbers of salmon in tributaries. The adjustment factor was determined subjectively in consultation with the snorkellers, taking into consideration the number and size of the pools in which complete counts could not be ascertained, and the number of salmon counted in adjacent pools.

Sections 1 & 2 of Flat Bay Brook were not surveyed in 2000 due to high water levels. The numbers of large and small salmon were estimated by assuming that the percentage of the total number of salmon in the Brook that was in Sections 1 & 2 in 2000 was equivalent to the average percentage in these Sections in 1998 and 1999 (calculated from data in Porter 1999, and Porter 2000a). Thus in 2000, it is estimated that 23.8 % of the small and 21.5% of the large salmon in Flat Bay Brook were in Sections 1 & 2.

There are many factors that affect accuracy and precision of the counts by individuals and collectively by the teams. These factors include water depth and width of pools, turbidity and colour of water, angle of sun, and light conditions in general. No adjustments were made to the counts to compensate for possible inaccuracies of counts or precision of estimates by individuals or teams. However, a preliminary test was conducted to evaluate the ability of the snorkellers to accurately count wooden model "test salmon" and categorise them as large (>63 cm) or small (<63 cm) in an experimental situation. Since the test methodology required further refinement the results were not used in this assessment; however, a description of the test and the results are given in Appendix 7.

The adjusted numbers of large and small salmon represent the total numbers in each river at the time of the survey, and assumed to approximate the spawning escapement. It is believed that the majority of spawners had entered the river prior to the survey and there is no information available on mortalities after the survey.

The total returns to each river was obtained by adding the number of salmon retained in the recreational fishery and 10% of the number of salmon hooked-and-released to the estimated spawning escapement. No adjustment was made for illegal removals.

Egg deposition

The unadjusted and adjusted egg deposition (ED_{ua} & ED_a) for Crabbes River, Middle Barachois Brook, Robinsons River, and Fischells Brook, in 2000, were calculated for small and large salmon separately then summed as follows:

(3) $$ED_{ua} = (UN_S * PF_S * RF_S * MW_S) + (UN_L * PF_L * RF_L * MW_L)$$

(4) $$ED_a = (AN_s * PF_S * RF_S * MW_S) + (AN_L * PF_L * RF_L * MW_L)$$

Where:
$UN_{S\,or\,L}$ = unadjusted numbers of small or large salmon counted in the survey
$PF_{S\,or\,L}$ = percent female small or large salmon
$RF_{S\,or\,L}$ = relative fecundity for small or large salmon (1540 eggs/kg)
$MW_{S\,or\,L}$ = mean weight for small or large salmon
$AN_{S\,or\,L}$ = adjusted number of small or large salmon counted in the survey

The unadjusted and adjusted egg deposition (ED_{ua} & ED_a) for Flat Bay Brook, in 2000, were calculated for small and large salmon separately then summed as follows:

(5) $$ED_{ua} = (UN_S * PF_S * F_{FS}) + (UN_L * PF_L * F_{FL})$$

(6) $$ED_a = (AN_s * PF_S * F_{FS}) + (AN_L * PF_L * F_{FL})$$

Where: $F_{FS\ or\ FL}$ = fecundity of small or large salmon for Flat Bay Brook based on length/fecundity relationship, y = 173.02x - 6266.8 (Porter and Bourgeois 1998).

Percentage of Conservation Level Achieved

The adjusted and unadjusted percentage of the conservation egg deposition levels achieved in each river in 2000 were calculated as follows:

(3) Percentage of conservation level achieved = $(ED_{ua\,or\,a} / CED) * 100$

Where: CED = Conservation Egg Deposition requirements

Results

Recreational Fisheries Data

The angling catch statistics for 2000 for Crabbes River, Middle Barachois Brook, Robinsons River, and Flat Bay Brook, as compiled from the angling licence stub returns, are provided in Table 4. Fischells Brook was closed to all angling. The catch statistics from 1974-2000 are also

provided in Appendices 1-5. (Note the 1999 catch statistics are the updated data.) Fisheries Guardians and/or River Monitors collected the angling data collected prior to 1996; thus, these data may not be directly comparable to the data derived from the license stub returns. Estimates of the angling effort are not available for 1996-2000, since many anglers did not properly record this information on their license return.

Crabbes River

There were 23 small and 25 large salmon hooked-and-released on Crabbes River in 2000, which is equivalent to an exploitation of 2.2% and 16.1% of the total returns of small and large salmon respectively to the river (Table 4). The total catch in 2000 is the lowest estimated since 1995 (Appendix 1).

Middle Barachois Brook

There were two small and no large salmon hooked-and-released on Middle Barachois Brook in 2000. The total catch in 2000 is the lowest ever recorded for this river (Appendix 2).

Robinsons River

An estimated 341 small salmon and 55 large salmon were hooked-and-released on Robinsons River in 2000, which is equivalent to exploitation of 23.9% and 17.1% of the estimated total returns of small and large salmon respectively to the river (Table 4). An estimated 98 small salmon were retained in the two-week retention fishery on Robinsons River, which is higher than the retained catch in 1995, the last previous year that there was a legal retention fishery (Appendix 3). The overall angling mortality of small salmon on Robinsons River, in 2000, was 132 fish equivalent to 9.3% of the total returns to the river (Table 4).

Flat Bay Brook

An estimated 442 small salmon and 112 large salmon were hooked-and-released on Flat Bay Brook, which is equivalent to exploitation of 19.2% and 23.5% of the estimated total returns of small and large salmon respectively to the river (Table 4). An estimated 130 small salmon were retained in the two-week retention fishery on Flat Bay Brook, which is slightly higher than the retained angling catch in 1994 when the river was open to angling for 14 weeks (Appendix 5). The overall angling mortality of small salmon on Flat Bay Brook was 174 fish equivalent to 7.5% of the total returns to the river (Table 4).

Unrecorded Mortalities

The estimated mortality for hooked-and-released small salmon ranged from zero (0) on Middle Barachois Brook to 44 on Flat Bay Brook. The estimated mortality for hooked-and-released large salmon was estimated to range from zero (0) on Middle Barachois Brook to 11 on Flat Bay Brook (calculated as 10% of the released salmon shown in Table 4). These mortality values have been included in the angling mortality for each river referenced in the above Section.

Biological Characteristics

The parameter values for mean weight, mean length, and percent female for small and large salmon used to calculate the total egg deposition in each river are provided in Table 3. The percentage of large salmon in each spawning population, in 2000, is shown in Tables 5 to 9. The length-fecundity relationship developed for Flat Bay Brook is y = 173.02x – 6266.8 (Porter and Bourgeois 1998).

Conservation Spawning Requirements

The number of eggs required for conservation in each river is provided in Table 1 and shown below:

Crabbes River	4,600,000 eggs
Middle Barachois Brook	2,100,000 eggs
Robinsons River	3,300,000 eggs
Fischells River	3,600,000 eggs
Flat Bay Brook	3,800,000 eggs

Number of Spawners and Total Returns to Rivers

Salmon were generally concentrated in a small number of pools in each river. Few salmon were found in riffles or in pools less than one (1) meter in depth, except in locations with cooler spring fed water. In river sections that have few pools and when water levels are medium height, some salmon are in riffle areas near large rocks and boulders. These conditions existed in 2000 in Section 4, Fischells Brook, and Sections 2 and 3, Robinsons River. Densities greater than 10 salmon were found in 12 pools in Crabbes River, 16 pools on Middle Barachois Brook, 13 pools in Robinsons River, 15 pools in Fischells Brook, and 16 pools on Flat Bay Brook. The unadjusted and the adjusted numbers of small and large salmon counted in Crabbes River, Middle Barachois Brook, Robinsons River, Fischells Brook, and Flat Bay Brook are provided in Tables 5 to 9 respectively. The overall adjustment factor for the count in each river ranged from 1.09 for Middle Barachois Brook to 1.62 for Flat Bay Brook (Tables 5-9). The rationale for choosing each adjustment factor is provided in Appendix 6. The adjusted counts of small and large salmon are assumed to be the number of spawners since there were no known removals subsequent to the survey. A summary of the estimated spawning escapements to these five rivers, 1996-2000, is provided in Table 10, and the estimated total returns to the rivers in Table 11. (Note the total returns for 1999 were updated from Porter, (2000a) using the updated angling catch statistics).

Crabbes River

The greatest numbers of salmon in Crabbes River were found in Section 2B, although pools with relatively high numbers were also found in Sections 1 and 3 (Table 5). The highest percentage (29%) of large salmon was found in Section 1. The water levels were low in Crabbes River in 2000, which provided an opportunity to survey the gorge (~1 km long) in Section 2 for the first

time since snorkeling surveys were initiated in 1996. The water conditions were such that a complete coverage (depth and width) could be made of all pools in the gorge, yet no salmon were observed. Little Crabbes River was not surveyed in 2000.

The total number of spawners estimated to be in Crabbes River in 2000 was 1176 salmon, of which 1024 (87.1%) were small and 152 (12.9%) were large salmon (Table 5). The spawning escapement of small salmon in 2000 is the second highest estimate since surveys began in 1996, and is 30% higher than the average number of small salmon spawners 1996-99 (Table 10). The spawning escapement (152) of large salmon, in 2000, is the lowest observed since surveys began in 1996. It is 44% lower than the average spawning escapement 1996-99. The annual total returns of small and large salmon to Crabbes River, 1996-2000, are provided in Table 11.

One rainbow trout was observed in Section 4 (Black Cliff Pool) during the survey and one was angled on 1 June in Section 4 (White Cliff Pool). The angled fish was sexed as an immature male and the scale age interpretation was one (1) year in fresh water and one (1) year at sea.

Middle Barachois Brook

Water levels were very low when Middle Barachois River was surveyed. Salmon were distributed throughout Sections 1, 2 and 3. No salmon were observed in Section 4 (Table 6). Fifty-five percent (55%) of the salmon were observed in Section 3. The highest percentage (14%) of large salmon was found in Section 1. No tributaries were surveyed in 2000. An exploratory survey was conducted in a 3 km Section of the main stem of the river above the falls located at the upstream boundary of Section 1. Fourteen (14) small and 10 large salmon were observed, most of which were in pools in series of small falls within 1 km upstream from the falls at the upper boundary of Section 1. In past years, no surveys were conducted above the falls since Fisheries Officers, guardians, local anglers, and survey crews considered the falls to be a complete barrier to upstream migrating salmon. Until further investigations can be conducted, and based on the small number of salmon observed above the falls, it is assumed that the falls is a serious barrier to upstream salmon migration and that only a small proportion of the spawning escapement surmounts the falls under some flow regimes. The salmon observed upstream from Section 1 were added to the Section 1 counts.

The total number of spawners in Middle Barachois Brook in 2000 was estimated to be 1297 salmon, of which 1142 (88%) were small salmon and 155 (12%) are large salmon (Table 6). The spawning escapement of small Atlantic salmon in 2000 is 42% higher than the 1996-99 average escapement (Table 10). The spawning escapement of large salmon is 67% higher than the average escapement 1996-99. The annual total returns of small and large salmon to Middle Barachois Brook, 1996-2000, are provided in Table 11.

Robinsons River

In Robinsons River, 87% of the salmon were located in Sections 1 and 2. The highest percentage (24%) of large salmon occurred in Section 2. It was estimated that 319 salmon were in the pool at the base of the falls (upper boundary, Section 1), which was surveyed for the first time. No survey was conducted of Northern Feeder, Section 4.

The total number of spawners in 2000 was estimated to be 1609 salmon, of which 1293 (80%) were small salmon and 316 (20%) were large salmon (Table 7). The spawning escapement of small salmon in 2000 is 22% higher than the average escapement 1996-99 (Table 10). The spawning escapement of large salmon is 93% higher than in the average escapement 1996-99. The annual total returns of small and large salmon to Robinsons River, 1996-2000, are provided in Table 11.

Fischells Brook

In Fischells Brook, 52% of the salmon were found in Section 2 (Table 8). No tributaries were surveyed in 2000.

The total number of spawners in 2000 was estimated to be 2076 salmon, of which 1800 (87%) were small salmon and 277 (13%) are large salmon (Table 8). Spawning Escapement of small salmon in 2000 was 162% higher than the average escapement 1996-99 (Table 10). The spawning escapement of large salmon was 112% higher than the average escapement 1996-99. The annual total returns of small and large salmon to Fischells Brook, 1996-2000, are provided in Table 11.

Flat Bay Brook

Sections 1 & 2 were not surveyed due to high water levels. Also, no tributaries were surveyed. It was estimated that 45% of the spawning escapement were located in Section 4 (Table 9).

The total number of spawners in 2000 was estimated to be 2600 salmon, of which 2134 (82%) were small salmon and 466 (18%) were large salmon (Table 9). The spawning escapement of small salmon in 2000 was 40% higher than the average escapement 1996-99 (Table 10). The spawning escapement of large salmon was 174% higher than the average escapement 1996-99 (Table 10). The total returns of small and large salmon to Flat Bay Brook, 1996-2000, are provided in Table 11.

Egg Deposition

The estimated egg deposition and percentage of conservation level achieved in 2000 are provided in Table 12, and summarized below. Estimates of the percentage of the conservation egg deposition levels achieved in each of the five rivers, 1996-2000, are provided in Table 13 and Figure 6.

River	Egg Deposition	% Conservation achieved
Crabbes River	$2.9*10^6$	63
Middle Barachois Brook	$2.0*10^6$	95
Robinsons River	$4.5*10^6$	135
Fischells Brook	$5.1*10^6$	142
Flat Bay Brook	$6.3*10^6$	167

External Marks or Scars

The numbers of salmon observed with external marks, which include net marks and other injuries, and the percent of total number of fish observed from 1997 to 2000, are shown below. The percent in parenthesis is the percent of the total number of salmon observed.

River	1997	1998	1999	2000
Crabbes River	13 (1.1%)	13 (3.2%)	10 (1.4%)	28 (2.7%)
M. Barachois Brook	9 (0.8%)	N/A	10 (1.8%)	47 (4.0%)
Robinsons River	22 (2.1%)	N/A	5 (0.4%)	4 (0.3%)
Fischells Brook	10 (1.7%)	2 (0.9%)	5 (0.4%)	13 (0.7%)
Flat Bay Brook	17 (1.3%)	N/A	12 (0.6%)	12 (0.8%)

Discussion

The procedures for conducting the snorkeling surveys continue to improve with the addition of more snorkellers in the larger pools and refinements of the field logistics. These improvements, as well as the increase in experience of the surveyors should have resulted in better estimates of population sizes in 2000 than in previous years; thus the adjustment factors tend to be slightly lower. The technique used to survey the pool at the base of the falls on Robinsons River worked well and should continue to be used in future surveys for pools that are too deep for snorkellers

to see the bottom. Water levels were particularly low and visibility was good when the surveys were conducted on Middle Barachois Brook and Sections 1-4 of Crabbes River. Section 1 of Flat Bay Brook could not be surveyed due to high discharge.

A preliminary test conducted in 2000 to evaluate snorkeller biases in counting and categorizing salmon into small (<63 cm) and large (>63 cm), indicated a wide range in differences among individuals (Appendix 7). The majority of the snorkellers counted fewer "test salmon" than were actually present. The snorkellers with 0% differences participated in placing some of the model fish in the river, thus may have influenced their accuracy. Overall the average number of large "test salmon" counted was 21.2% less than the actual number, and the average number of small "test salmon" counted was 2.8% less. The total number of small and large "test salmon" counted was 7.5% less than the actual number. None of the nine snorkellers obtained a count greater than the actual total number of "test salmon". These biases were not used to adjust the numbers of salmon counted in the spawner surveys because of the uncertainty of applying biases in counting model "test salmon" to counting real salmon. During actual survey conditions, salmon move when approached by the surveyor, which may cause it to be more easily detected than "test salmon". However, it can be concluded that snorkellers tend to underestimate both the total number of salmon and the size of the salmon. This apparent bias is consistent with providing a minimum estimate of the number of spawners in each river. Bias by snorkellers in counting large numbers of fish and categorizing their size needs to be further examined. Bias is difficult to determine due to differences in water conditions such as turbidity, water depth, water color, angle of the suns rays, and light intensity throughout a river and between rivers. Bias may also be related to individual snorkeller differences such as quality of sight including peripheral vision, and attention span.

The spawning escapements of small Atlantic salmon in Crabbes River was 44% higher in 2000 than in 1999 and 30% higher than the average escapement from 1996 to 1999 however, the spawning escapement of large salmon declined by 42% from 1999 and 44% from the 1996-99 average escapement (Table 10). The resultant egg deposition in 2000 was estimated to be 63% of the river's threshold conservation level, which is slightly below the 1999 and average 196-99 values (Table 13, Fig. 6). There was no information available that explains the low spawning escapement of large salmon.

The conservation egg deposition level (95%) achieved in Middle Barachois Brook in 2000 was 121% higher than estimated for 1999 and 51% higher than the estimated average level 1996-99 (Table 13, Fig. 6). There was considerable fluctuation in spawning stock size over the four years that pre-spawner counts have been conducted, possibly caused by the severe fluctuations in water levels and temperatures that occur in this river. The water levels were very low during the survey in 2000 and water temperatures of 25°C were recorded. Some salmon were observed stranded in small pockets of water. The low water levels and good visibility resulted in a high degree of confidence in the counts and thus a low adjustment factor (Appendix 6). The discovery of salmon above the falls at the upper boundary of Section 1 adds complication to the assessments. Although it is believed that the falls is a barrier under most flow conditions, further in-stream surveys are required to determine the extent that the upstream habitat is utilized. Porter (2000a) provides a detailed summary of the biological characteristics of salmon from Middle Barachois River sampled in 1998. It is of interest to note that 26.7% of the virgin 2 SW

salmon are in the small category measuring between 60 cm and 62.5 cm in fork length. All of the 2 SW salmon were females. The small size of the 2 SW salmon in Middle Barachois Brook is undoubtedly related to the early run timing of these salmon. Some salmon are known to enter Middle Barachois Brook and several other rivers in Bay St. George in late April and early May; therefore, they would not have the opportunity to increase in size after their last winter at sea. **Thus, when a retention fishery opens on Middle Barachois Brook, it would be appropriate to permit only retention of salmon <60 cm in fork length, if the management objective is to minimize angling mortality of 2 SW salmon. Similar consideration would be appropriate for all early run salmon rivers in Bay St. George. It is recommended that there be no retention angling fishery on Middle Barachois Brook in 2001, since this river has not achieved its conservation egg deposition requirements from 1996 to 2000.**

The spawning escapements of small salmon estimated for both Robinsons River and Flat Bay Brook in 2000 are slightly lower (about 100 fish) than in 1999; but there was an increase in the estimated number of large salmon for both rivers (Table 10). Thus the resultant egg depositions and conservation egg deposition levels achieved in 2000 are the highest recorded for each river since the pre-spawner surveys began in 1996 (Table 13). Reddin and Mullins (1996) indicated higher percentages of the conservation egg depositions were attained on Robinsons River in 1980 and 1981; but all of their estimates for Flat Bay Brook were less than the 167% estimated for 2000. Both Robinsons River and Flat Bay Brook were open for a 2-week retention angling in 2000. Flat Bay Brook was closed to all angling in 1995 and 1996, and was closed to retention from 1997 to 1999. Robinsons was closed to retention angling from 1996 to 1999. The number of small salmon (98) retained in the 2-week season on Robinsons River is higher than the catch in the 14 week season in 1995 (Appendix 3), which suggests that the population size is larger in 2000 than in 1995. Similarly, the number of small salmon (130) retained on Flat Bay Brook in 2000 is higher than in 1994 (Appendix 5), again suggestive of a higher population size. The 2-week retention-angling fishery resulted in about 6% and 7% harvest of the small salmon that entered Flat Bay Brook and Robinsons River respectively (Table 4). **It is anticipated that a 2-week retention angling fishery could occur on Robinsons River and Flat Bay Brook in 2001 without negatively affecting the conservation egg deposition levels, given the recent increasing trends in returns and the observed low exploitations in 2000.**

The spawning escapements in Fischells Brook of both large and small salmon showed an increase in 2000 over 1999 (Table 10). The Brook exceeded its egg deposition conservation requirement in both 2000 (142%) and in 1999 (110%) (Table 13, Fig 6). These values are in marked contrast to the 44% and 23% attained in 1997 and 1998 respectively (Table 13, Fig. 6). No information is available that explains this abrupt increase in spawning escapement; although the severe flows in February of 1996 may have been a contributing factor. There has been a request to have a 2-week retention-angling fishery for small salmon on Fischells Brook in 2001. **Given the recent increases in returns to Fischells Brook and the low exploitations observed in the 2-week retention periods on Flat Bay Brook and Robinsons River in 2000, it is advised that a 2-week retention fishery is unlikely to have a serious negative effect on the conservation level provided that a precautionary approach be taken. This precautionary approach should include: 1) the retention period be at the same time as the one on Flat Bay Brook and Robinsons River; 2) fishing be permitted only downstream of the steadies; and 3) no hook-and-release fishery occur outside the 2-week retention period.**

The proportion of large salmon in the spawning escapements as estimated from the visual surveys in 2000 are quite variable for all rivers when compared to previous years (see the text Table below). Notable increases occurred in Flat Bay Brook and Robinsons River, while a decline in the proportion of large salmon was observed in Crabbes River.

	Percent large salmon				
	1996	1997	1998	1999	2000
Crabbes River	22.1	23.6	26.2	24.9	12.9
Middle Barachois Brook	4.3	14.9	N/A	9.9	11.4
Robinsons River	13.5	14.5	N/A	13.5	19.6
Fischells Brook	N/A	10.8	27.0	18.1	13.3
Flat Bay Brook	9.7	11.5	N/A	10.5	17.9

River specific salmon weight and sex ratio data are required to improve the stock assessment for Crabbes and Robinsons rivers and Fischells and Flat Bay brooks. Sampling was conducted in the recreational fisheries in 2000. Although the sample sizes were relatively small, they did indicate that the percent female and the mean weights were less than the default values currently being used. Additional samples are required and a complete review of the biological characteristic database for these rivers is warranted.

There appeared to be an increase in the number of external marks observed on salmon in Crabbes River and Middle Barachois Brook in 2000 compared to 1999. Water levels were particularly low in these rivers in August, and many of the marks appear to be injuries from foul hooking, jigging, predator birds, or from fish hitting rocks during their upstream migration. A small proportion of the scars appeared to be net marks. The observations by snorkellers of scars on salmon are underestimates of the actual number of marked, since it is difficult to see and keep account of marks when there are large numbers of fish in a pool.

The information available for this assessment does not lend itself to forecasting the abundance of salmon in 2000.

The origins of the two rainbow trout observed in Crabbes River are not known. One of these rainbow trout was identified as an immature male. Scale interpretation indicated that it had spent one year in freshwater before entering the marine environment, which is consistent with the freshwater age of an aquaculture fish. This fish is probably of non-Newfoundland origin. The aquaculture industry in Bay d'Espoir has been using only all-female triploid or all-female diploid salmon in its grow out operations. There has been no confirmed naturally reproducing population of rainbow trout in Bay St. George. Marine cage rearing of rainbow trout occurs in Bay d'Espoir, Newfoundland, Nova Scotia and Bay of Fundy, New Brunswick. Documentation of observations of rainbow trout in Newfoundland are provided in Porter (2000b)

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Table 1. Drainage area, fluvial habitat, and egg deposition levels required for conservation in five rivers in Bay St. George.

River Name	Drainage Area (sq. km)	Fluvial Rearing Units (100 sq. m)	Standing Water (ha)	Conservation Requirement Eggs ($x10^6$)
CrabbesRiver	551	18,429	381	4.6
Middle Barachois Brook	241	8,395	362	2.1
Robinsons River	439	13,491	124	3.3
Fischells River	360	13,661	948	3.6
Flat Bay Brook	635	16,012		3.8
Total	2,226	69,988	1,814	17.4

Table 2. Seasons and quotas, where applicable, for small salmon (< 63 cm) in the angling fishery for five rivers in SFA 13, 1953-99. Hook and Release only is indicated by H&R

Years	Crabbes	M. Barachois (Quota)	Robinsons (Quota)	Fischells (Quota)	Flat Bay (Quota)
1953-77	14 May –15 Sep	14 May –15 Sep	14 May –15 Sep	14 May –15 Sep	14 May –15 Sep
1978-84	1 Jul – 31 Aug	1 Jul – 31 Aug	1 Jul – 31 Aug	1 Jul – 31 Aug	1 Jul – 31 Aug
1985	8 Jun – 2 Sep	8 Jun – 2 Sep	8 Jun – 2 Sep	8 Jun – 2 Sep	8 Jun – 2 Sep
1986	1 Jun – 7 Sep	1 Jun – 7 Sep (350)	1 Jun – 7 Sep	1 Jun – 7 Sep	1 Jun – 7 Sep (400)
1987	1 Jun – 7 Sep	1 Jun – 7 Sep (350)	1 Jun – 7 Sep	1 Jun – 7 Sep	1 Jun – 7 Sep (300)
1988	1 Jun – 7 Sep	1 Jun – 7 Sep (175)	1 Jun – 7 Sep	1 Jun – 7 Sep	1 Jun – 7 Sep (300)
1989-94	1 Jun – 7 Sep	1 Jun – 7 Sep (175)	1 Jun – 7 Sep	1 Jun – 7 Sep (200)	1 Jun – 7 Sep (250)
1995	3 Jun – 17 Sep	3 Jun – 17 Sep (175)	3 Jun – 17 Sep	3 Jun – 17 Sep (200)	Closed
1996	1 Jun – 2 Sep (H&R)	1 Jun – 2 Sep (H&R)	1 Jun – 2 Sep (H&R)	1 Jun – 2 Sep	Closed
1997	1 Jun – 1 Sep (H&R)	1 Jun – 1 Sep (H&R)	1 Jun – 1 Sep (H&R)	1 Jun – 1 Sep	1 Jun – 1 Sep (H&R)
1998	6 Jun – 7 Sep (H&R)	6 Jun – 7 Sep (H&R)	6 Jun – 7 Sep (H&R)	6 Jun – 7 Sep (H&R)	6 Jun – 7 Sep (H&R)
1999	1 Jun – 7 Sep (H&R)	1 Jun – 7 Sep (H&R)	1 Jun – 7 Sep (H&R)	(Closed)	1 Jun – 7 Sep (H&R)
2000	1 Jun – 7 Sep (H&R)	1 Jun – 7 Sep (H&R)	1–23 Jun (H&R) 24 Jun – 9 Jul Retention fishery 10 Jul- 7 Sep (H&R)	(Closed)	1–23 Jun (H&R) 24 Jun – 9 Jul Retention fishery 10 Jul- 7 Sep (H&R)

Table 3. Biological characteristics of salmon in five Bay St. George rivers.

River	Small salmon			Large salmon		
	% Female	Mean Wt(kg)	Mean Lth(cm)	% Female	Mean Wt(kg)	Mean Lgth(cm)
Crabbes	71.9	1.63	N/A	86.8	5.06	N/A
Middle Barachois	54.3	1.4	51.9	94.1	2.9	67.0
Robinsons	71.9	1.63	N/A	86.8	5.06	N/A
Fischells	71.9	1.63	N/A	86.8	5.06	N/A
Flat Bay	71.9	1.34	53.4	66.7	3.31	69.1

Table 4. Number of salmon retained and released in the angling fishery on four Bay St. George rivers, 2000. Mortality is assumed to equal to the retained angled salmon plus 10% of the released salmon. Percent (%) of returns is the percent of total returns to the river

	Crabbes		M. Barachois		Robinsons		Flat Bay	
Small Salmon	Fish	% of returns	Fish	% of returns	Fish	% of returns	Fish	% of returns
Released	23	2.2	2	0.2	341	23.9	442	19.2
Retained	0	0	0	0	98	6.9	130	5.6
Estimated Mortality	2	0.2	0	0	132	9.3	174	7.5
Large Salmon								
Released	25	16.1	0	0	55	17.1	112	23.5
Retained	0	0	0	0	0	0	0	0
Estimated Mortality	3	1.9	0	0	6	1.9	11	2.3

Table 5. Number of small and large salmon counted in Crabbes River, 14-16 August 2000.

River Section	# pools > 10 fish	Unadjusted Count		Adjustment Factor	Adusted Count			Percent Large
		Small	Large		Small	Large	Total	
1	2	133	54	1.10	146	59	205	28.9
2A	1	62	12	1.05	65	13	78	16.2
Gorge	0	0	0	1.00	0	0	0	
2B	2	362	50	1.15	416	57	474	12.1
3	4	219	4	1.15	252	5	256	1.8
4	2	42	3	1.10	46	3	50	6.7
5	1	89	13	1.10	98	14	112	12.7
L Crabbes	Not Surveyed							
TOTAL	12	907	136	1.13	1024	152	1175	12.9

Table 6. Number of small and large salmon counted in Middle Barachois Brook, 1-3 August 2000.

River Section	# pools > 10 fish	Unadjusted Count		Adjustment Factor	Adusted Count			Percent Large
		Small	Large		Small	Large	Total	
1	3	131	21	1.05	138	22	160	13.8
2	6	350	36	1.10	385	40	425	9.3
3	7	563	85	1.10	619	94	713	13.1
4	0	0	0	1.00	0	0	0	0.0
Big Dribble	Not Surveyed					0	0	0.0
TOTAL	16	1044	142	1.09	1142	155	1297	12.0

Table 7. Number of small and large salmon counted in Robinsons River, 16,17, & 23 August 2000

River Section	# pools > 10 fish	Unadjusted Count		Adjustment Factor	Adusted Count			Percent Large
		Small	Large		Small	Large	Total	
Pool at Falls	1	210	35	1.3	273	46	319	14.3
1	6	218	39	1.05	229	41	270	15.2
2	3	512	157	1.20	614	188	803	23.5
3	0	11	1	2.00	22	2	24	8.3
4	3	119	30	1.30	155	39	194	20.1
N. Feeder	Not Surveyed							
TOTAL	13	1070	262	1.21	1293	316	1609	19.6

Table 8. Number of small and large salmon counted in Fischells Brook, 19-20 August 2000.

River Section	# pools > 10 fish	Unadjusted Count		Adjustment Factor	Adusted Count			Percent Large
		Small	Large		Small	Large	Total	
1	2	98	44	1.20	118	53	170	31.0
2	5	834	107	1.15	959	123	1,082	11.4
3(Steadies)		282	49	1.15	324	56	381	14.8
4	7	285	31	1.15	328	36	363	9.8
5	1	62	7	1.15	71	8	79	10.1
TOTAL	15	1561	238	1.15	1800	276	2076	13.3

Table 9. Number of small and large salmon counted in Flat Bay Brook, 20-22 August 2000

River Section	# pools > 10 fish	Unadjusted Count		Adjustment Factor	Adusted Count			Percent Large
		Small	Large		Small	Large	Total	
1&2				*	508	100	608	16.5
3	4	335	64	1.15	385	74	459	16.0
4	5	759	184	1.25	949	230	1,179	19.5
5	7	146	31	2.00	292	62	354	17.5
TOTAL	16	1240	279	1.62	2134	466	2600	17.9

* See Appendix 6

Table 10. Spawning escapements of Atlantic salmon to five Bay St. George rivers, 1996 to 2000. Table is an update from Porter (2000a).

Year	Crabbes		M. Barachois		Robinsons		Fishells		Flat Bay	
	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
1996	844	239	805	36	768	120	N/A	N/A	1051	112
1997	1121	346	1044	182	1017	172	599	73	1282	167
1998	482	234	N/A	N/A	N/A	N/A	194	72	N/A	N/A
1999	709	263	560	66	1399	200	1264	246	2237	231
2000	1024	152	1142	155	1293	316	1800	276	2134	466
Mean 96-99	789	271	803	95	1061	164	686	130	1523	170

Table 11. Estimated total returns of Atlantic salmon to five Bay St. George rivers, 1996 to 2000. Table is an update from Porter (2000a).

Year	Crabbes		Middle Barachois		Robinsons		Fishells		Flat Bay	
	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
1996	866	249	825	40	866	137	N/A	N/A	1233	132
1997	1152	358	1060	190	1077	190	797	86	1307	173
1998	491	240	N/A	N/A	N/A	N/A	215	72	N/A	N/A
1999	712	264	563	62	1431	204	1264	246	2263	235
2000	1026	155	1142	155	1425	322	1800	276	2308	477
Mean 96-99	805	278	816	97	1125	177	759	135	1601	180

Table 12. Adjusted and unadjusted numbers of small and large Atlantic salmon spawners, estimated egg deposition, and percentage of egg deposition required for conservation that was attained in five Bay St. George rivers,in 2000.

River	Small salmon		Large salmon		Egg deposition		% Conservation level	
	unadjusted	adjusted	unadjusted	adjusted	unadjusted	adjusted	unadjusted	adjusted
Crabbes River	904	1024	136	152	2551447	2876248	55	63
M. Barachois Bk	1044	1142	142	155	1818975	1988337	87	95
Robinsons River	1070	1293	262	316	3703289	4471012	112	135
Fischells River	1561	1800	238	276	4427131	5115511	123	142
Flat Bay Brook	1240	2134	279	466	3708827	6329079	98	167

Table 13. Percentage of the Atlantic salmon egg deposition level required for conservation that was achieved on five rivers in Bay St. George, 1996-00 Table is updated from Porter (2000a).

Year	Crabbes	M. Barachois	Robinsons	Fischells	Flat Bay
1996	68	52	87	N/A	85
1997	95	95	91	44	89
1998	53	N/A	N/A	23	N/A
1999	66	43	118	110	149
2000	63	95	135	142	167
Mean 96-99	71	63	92	59	108

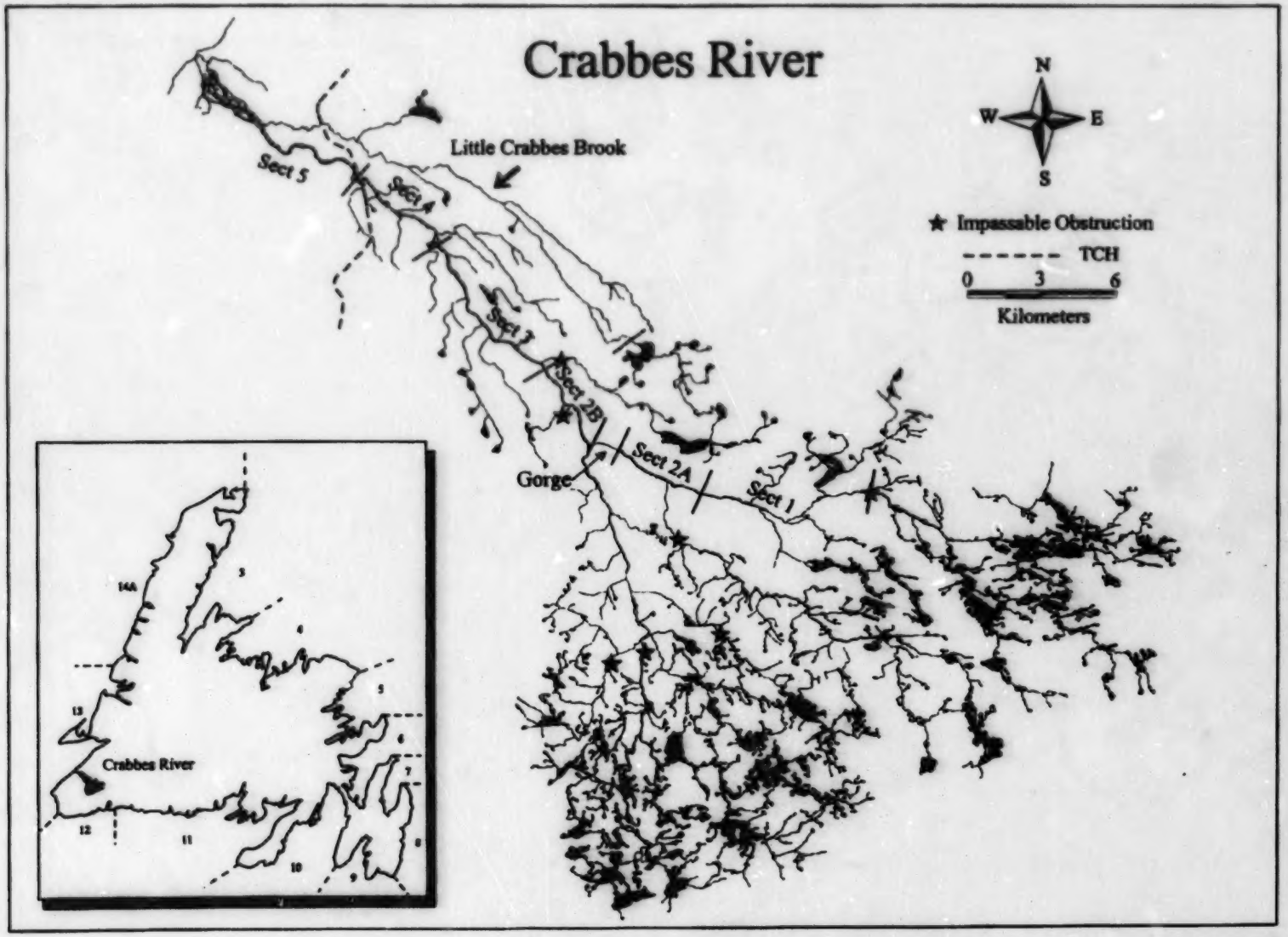


Figure 1. Map showing sections of Crabbes River in which visual surveys were conducted, 2000. Inset shows the Salmon Fishing Areas in Newfoundland and the location of Crabbes River.

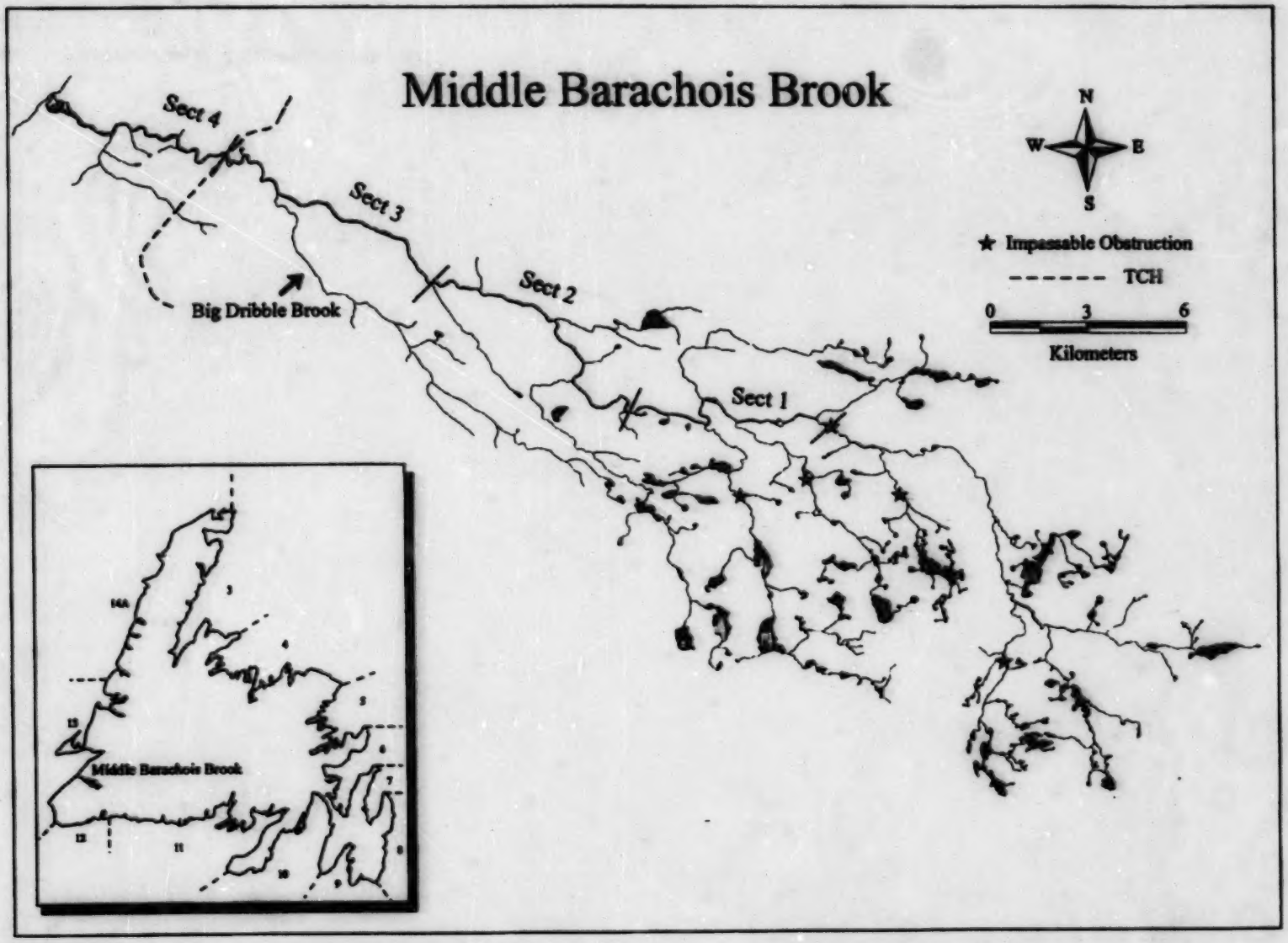


Figure 2. Map showing sections of Middle Barachois Brook in which visual surveys were conducted, 2000. Inset shows the Salmon Fishing Areas in Newfoundland and the location of Middle Barachois Brook.

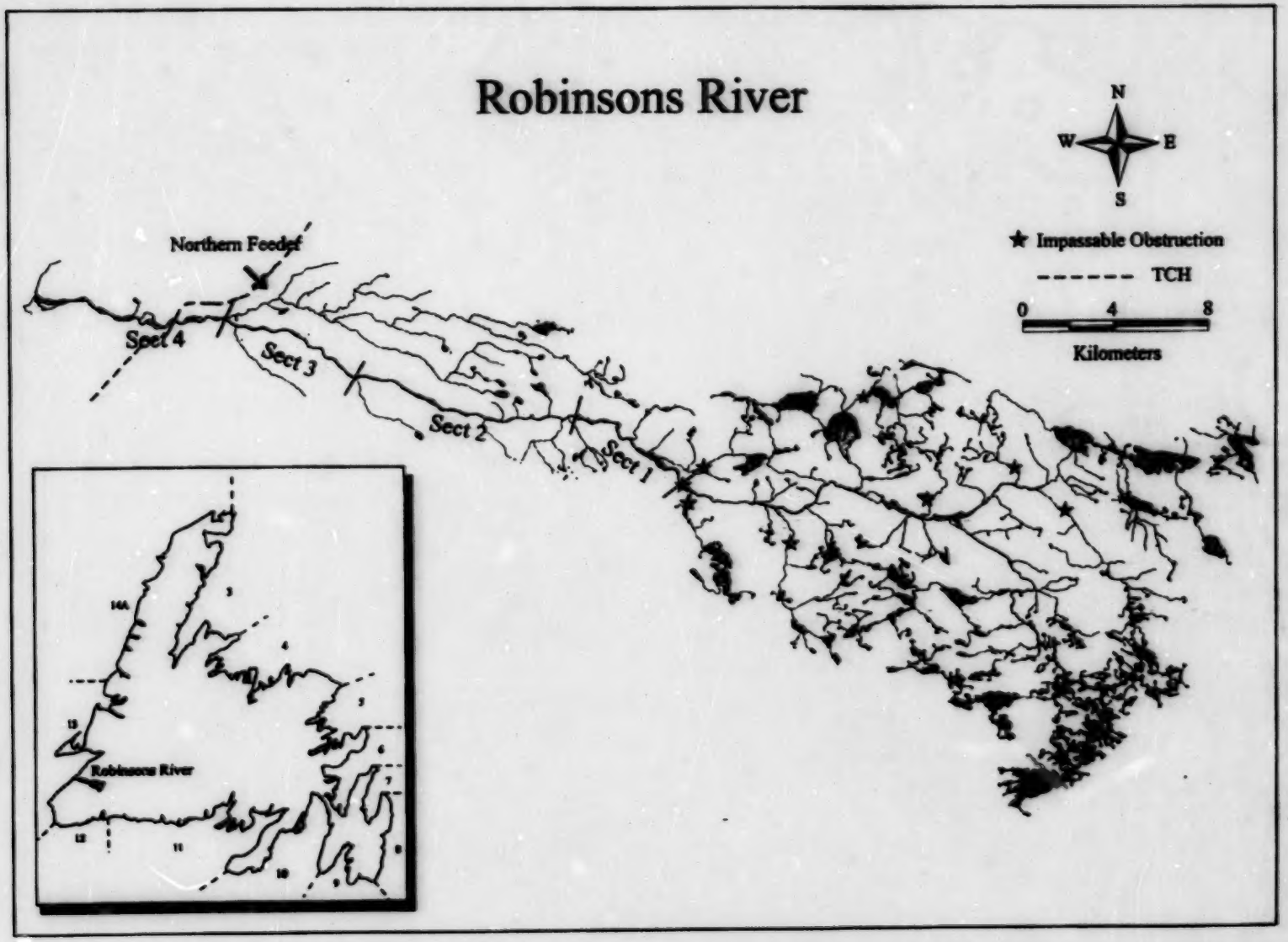


Figure 3. Map showing sections of Robinsons River in which visual surveys were conducted, 2000. Inset shows the Salmon Fishing Areas in Newfoundland and the location of Robinsons River.

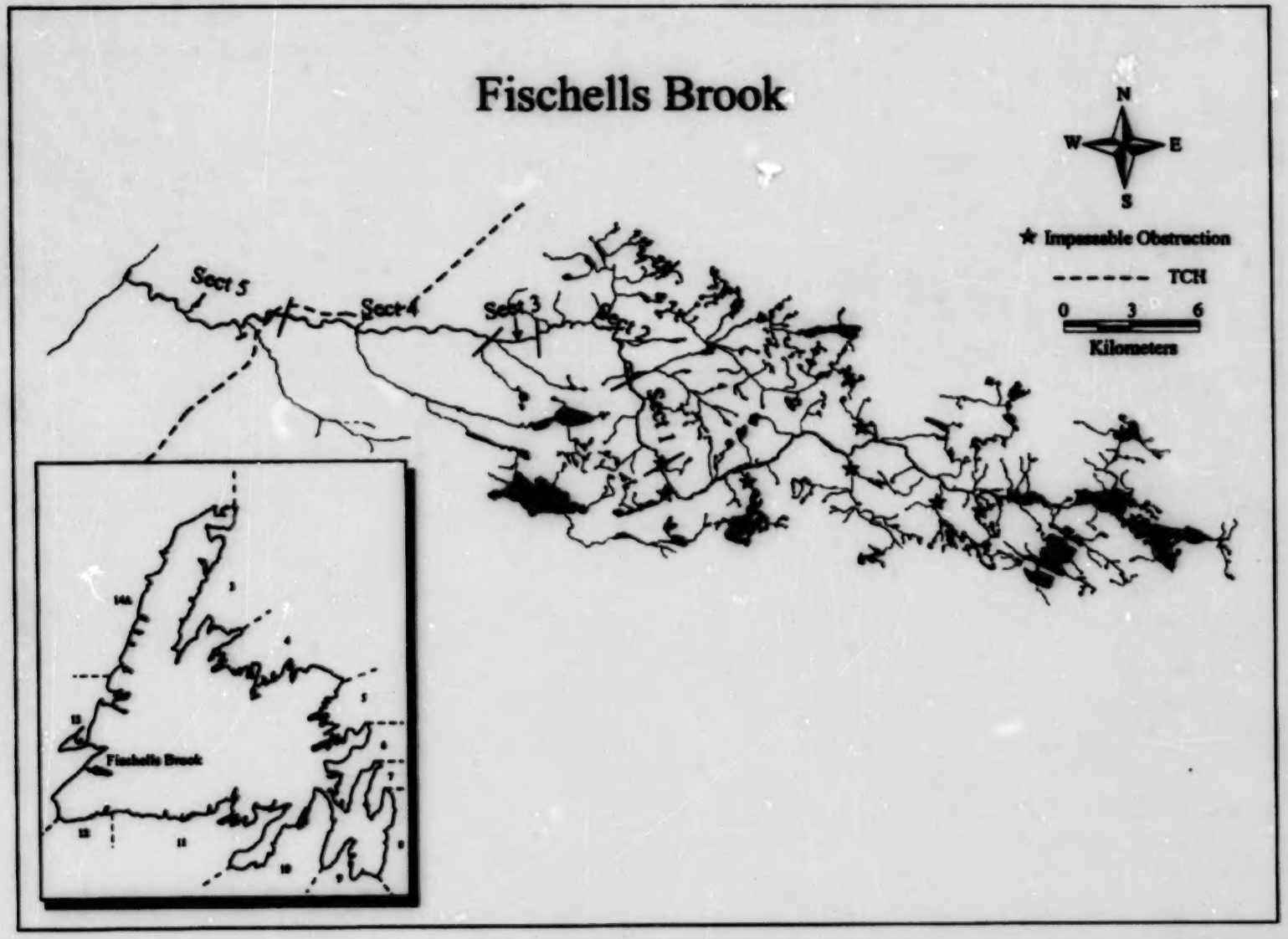


Figure 4. Map showing sections of Fischells Brook in which visual surveys were conducted, 2000. Inset shows the Salmon Fishing Areas in Newfoundland and the location of Fischells Brook.

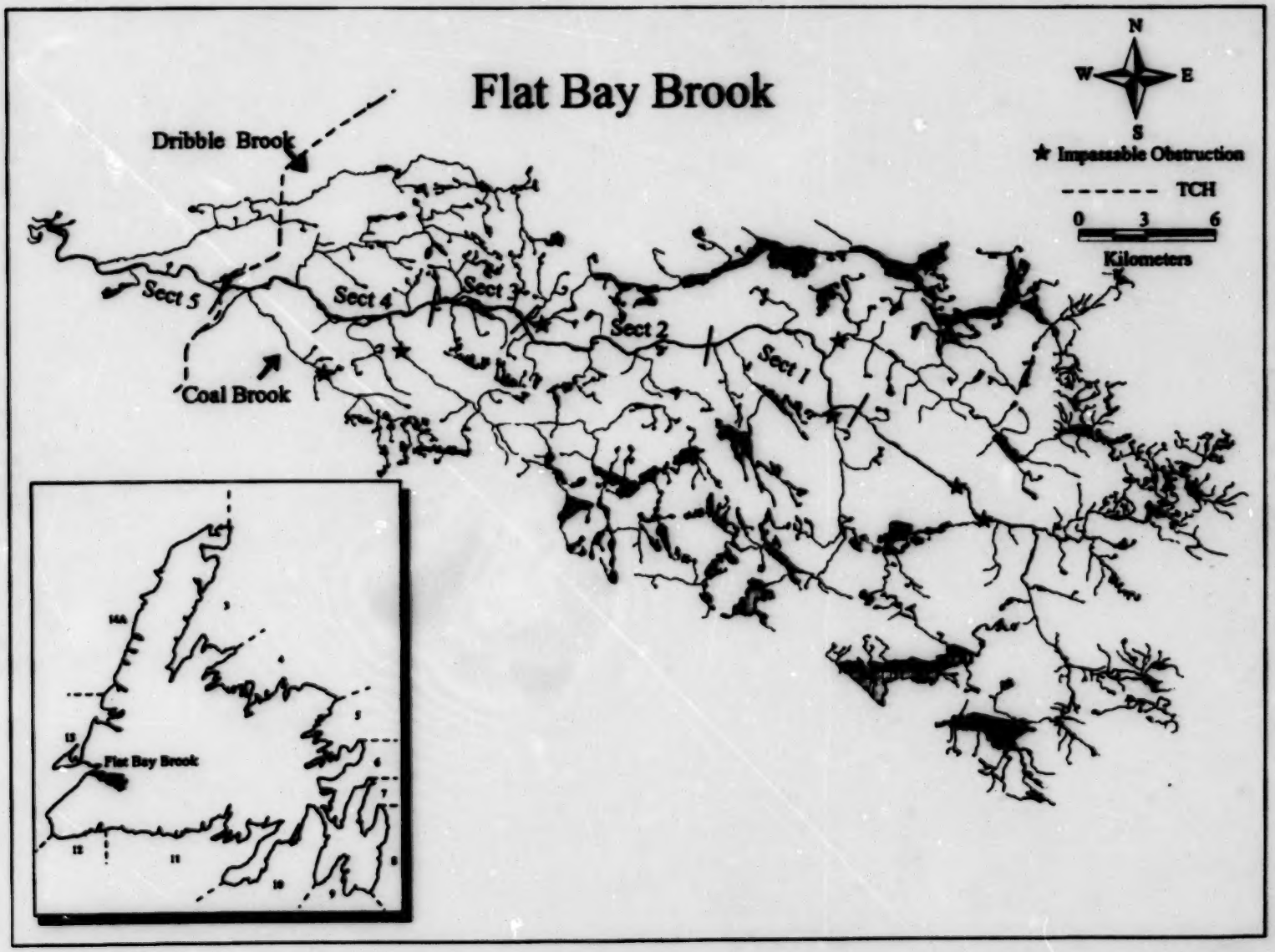
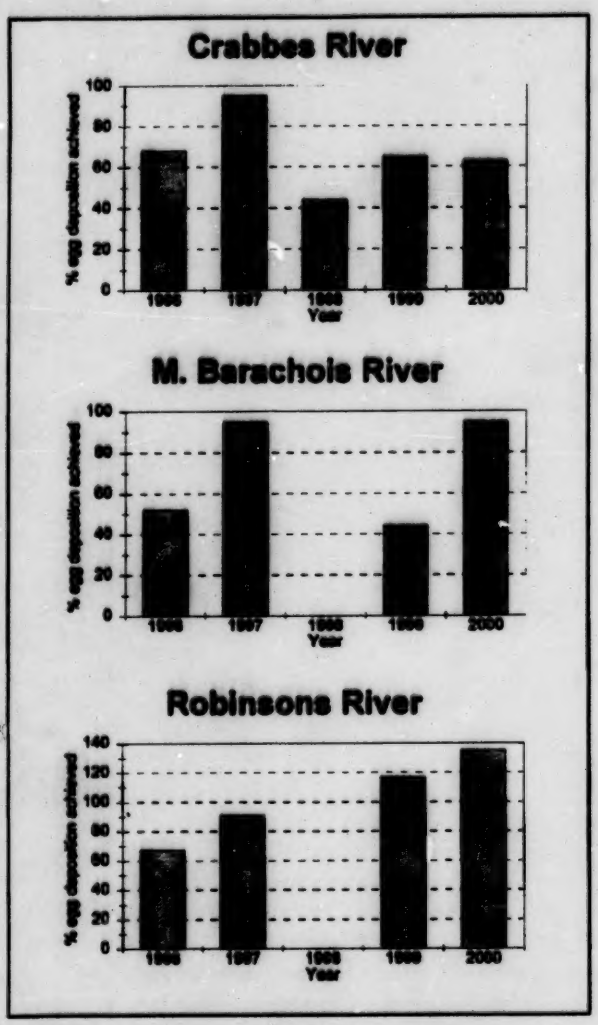


Figure 5. Map showing sections of Flat Bay Brook in which visual surveys were conducted, 2000. Inset shows the Salmon Fishing Areas in Newfoundland and the location of Flat Bay Brook.



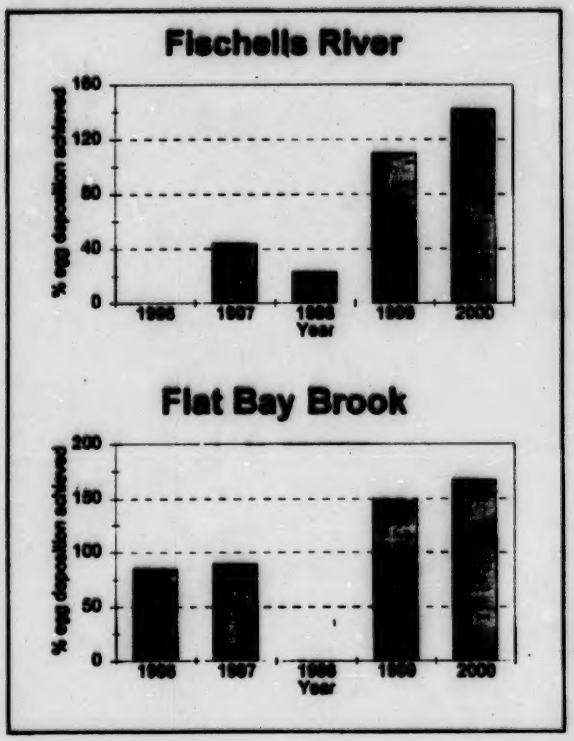


Figure 6. Percent of the Conservation Egg Deposition Requirements acheived, 1996-00.

Appendix 1. Angling catch statistics for Crabbes River. Data for 1974-1995 were collected by DFO River Guardians, and data for 1996-2000 are from the license stub return. 2000 data are preliminary.

River: Crabbes River — Code: 4000860

Year	Effort Rod Days	Small (<63 cm) Ret.	Small (<63 cm) Rel.	Small (<63 cm) Tot.	Large (>=63 cm) Ret.	Large (>=63 cm) Rel.	Large (>=63 cm) Tot.	Total (Small + Large) Ret.	Total (Small + Large) Rel.	Total (Small + Large) Tot.	CPUE
1974	1010	294	.	294	98	.	98	392	.	392	0.39
1975	1641	270	.	270	90	.	90	360	.	360	0.22
1976	859	191	.	191	58	.	58	249	.	249	0.29
1977	859	217	.	217	126	.	126	343	.	343	0.40
1978	907	138	.	138	127	.	127	265	.	265	0.29
1979	501	229	.	229	14	.	14	243	.	243	0.49
1980	902	363	.	363	91	.	91	454	.	454	0.50
1981	905	389	.	389	115	.	115	504	.	504	0.56
1982	1135	561	.	561	75	.	75	636	.	636	0.56
1983	758	105	.	105	38	.	38	143	.	143	0.19
1984	848	394	.	394	14	.	14	408	.	408	0.48
1985	602	95	.	95	*	3	3	95	3	98	0.16
1986	997	347	.	347	*	0	0	347	0	347	0.35
1987	377	84	.	84	*	4	4	84	4	88	0.23
1988	773	284	.	284	*	17	17	284	17	301	0.39
1989	419	47	.	47	*	5	5	47	5	52	0.12
1990	457	112	.	112	*	25	25	112	25	137	0.30
1991	385	103	.	103	*	9	9	103	9	112	0.29
1992	822	263	26	289	*	88	88	263	114	377	0.46
1993	737	150	0	150	*	24	24	150	24	174	0.24
1994	906	174	37	211	*	45	45	174	82	256	0.28
1995	268	26	5	31	*	32	32	26	37	63	0.24
1996**		-	221	221	*	96	96	-	317	317	
1997**		3	278	281	*	119	119	3	397	400	
1998**		-	91	91	*	55	55	-	146	146	
1999**		-	59	59	*	18	18	-	77	77	
2000**		-	23	23	*	25	25	-	48	48	
84-89 X	669.3	208.5	.	208.5	.	5.8	7.2	210.8	5.8	215.7	0.32
95% CL	258.3	158.3	.	158.3	.	8.1	7.1	162.0	8.1	161.6	0.14
N	6	6	0	6	0	5	6	6	5	6	6
86-91 X	568.0	162.8	.	162.8	.	10.0	10.0	162.8	10.0	172.8	0.30
95% CL	269.9	128.0	.	128.0	.	9.8	9.8	128.0	9.8	127.3	0.09
N	6	6	0	6	0	6	6	6	6	6	6
92-95 X	683.3	153.3	17.0	170.3	.	47.3	47.3	153.3	64.3	217.5	0.32
95% CL	453.9	155.6	27.8	173.2	.	45.4	45.4	155.6	65.9	210.8	0.18
N	4	4	4	4	0	4	4	4	4	4	4
96-99 $\bar{X}$			162.3	163.0	.	72.0	72.0		234.3	235.0	
95% CL			165.8	167.6	.	71.1	71.1		235.7	237.5	
N			4	4	0	4	4		4	4	

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1985-1995 AND ON RETAINED FISH ONLY PRIOR TO 1985.

* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.

**DATA OBTAINED FROM THE LICENSE STUB RETURN; 2000 DATA ARE PRELIMINARY

1996-2000 CATCH AND RELEASE ONLY.

Appendix 2. Angling catch statistics for Middle Barachois Brook. Data for 1974-1995 were collected by DFO River Guardians, and data for 1996-2000 are from the license stub return. 2000 data are preliminary.

River: Middle Barachois Brook — Code: 4000900

	Effort	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			
Year	Rod Days	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	CPUE
1974	894	257	.	257	70	.	70	327	.	327	0.37
1975	1129	510	.	510	117	.	117	627	.	627	0.56
1976	1572	526	.	526	46	.	46	572	.	572	0.36
1977	1218	534	.	534	56	.	56	590	.	590	0.48
1978	273	51	.	51	102	.	102	153	.	153	0.56
1979	342	124	.	124	0	.	0	124	.	124	0.36
1980	622	290	.	290	24	.	24	314	.	314	0.50
1981	487	210	.	210	3	.	3	213	.	213	0.44
1982	313	137	.	137	2	.	2	139	.	139	0.44
1983	292	84	.	84	1	.	1	85	.	85	0.29
1984	320	158	.	158	0	.	0	158	.	158	0.49
1985	422	98	.	98	*	1	1	98	1	99	0.23
1986	683	200	.	200	*	23	23	200	23	223	0.33
1987	208	51	.	51	*	0	0	51	0	51	0.25
1988	565	202	.	202	*	11	11	202	11	213	0.38
1989	395	79	.	79	*	1	1	79	1	80	0.20
1990	547	138	.	138	*	7	7	138	7	145	0.27
1991	293	68	.	68	*	6	6	68	6	74	0.25
1992	535	222	0	222	*	22	22	222	22	244	0.46
1993	916	230	23	253	*	11	11	230	34	264	0.29
1994	785	154	25	179	*	14	14	154	39	193	0.25
1995	341	53	2	55	*	24	24	53	26	79	0.23
1996**		-	195	195	*	35	35	-	230	230	
1997**		-	158	158	*	81	81	-	239	239	
1998**		-	6	6	*	23	23	-	29	29	
1999**		-	14	14	*	2	2	-	16	16	
2000**		-	2	2	*	0	0	-	2	2	
84-89 X	432.2	131.3	.	131.3	.	7.2	6.0	131.3	7.2	137.3	0.32
95% CL	178.7	67.6	.	67.6	.	12.3	9.8	67.6	12.3	75.3	0.10
N	6	6	0	6	0	5	6	6	5	6	6
86-91 X	448.5	123.0	.	123.0	.	8.0	8.0	123.0	8.0	131.0	0.29
95% CL	189.6	70.5	.	70.5	.	8.8	8.8	70.5	8.8	78.0	0.07
N	6	6	0	6	0	6	6	6	6	6	6
92-95 X	644.3	164.8	12.5	177.3	.	17.8	17.8	164.8	30.3	195.0	0.30
95% CL	408.3	130.4	21.2	138.4	.	9.9	9.9	130.4	12.2	131.9	0.14
N	4	4	4	4	0	4	4	4	4	4	4
96-99 X			93.3	93.3	.	35.3	35.3		128.5	128.5	
95% CL			154.9	154.9	.	53.2	53.2		195.0	195.0	
N			4	4	0	4	4		4	4	

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.
CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1985-1995 AND ON RETAINED FISH ONLY PRIOR TO 1985.
* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.
**DATA OBTAINED FROM THE LICENSE STUB RETURN; 2000 DATA ARE PRELIMINARY
1996-2000 CATCH AND RELEASE ONLY.

Appendix 3. Angling catch statistics for Robinsons River. Data for 1974-1995 were collected by DFO River Guardians, and data for 1996-2000 are from the license stub return. 2000 data are preliminary.

River: Robinsons River — Code: 4000920

Year	Effort Rod Days	Small (<63 cm) Ret.	Rel.	Tot.	Large (>=63 cm) Ret.	Rel.	Tot.	Total (Small + Large) Ret.	Rel.	Tot.	CPUE
1974	1134	354	.	354	17	.	17	371	.	371	0.33
1975	1556	611	.	611	42	.	42	653	.	653	0.42
1976	1842	556	.	556	56	.	56	612	.	612	0.33
1977	1184	403	.	403	184	.	184	587	.	587	0.50
1978	671	235	.	235	68	.	68	303	.	303	0.45
1979	989	495	.	495	23	.	23	518	.	518	0.52
1980	1352	684	.	684	113	.	113	797	.	797	0.59
1981	1527	861	.	861	129	.	129	990	.	990	0.65
1982	1648	905	.	905	41	.	41	946	.	946	0.57
1983	2580	278	.	278	210	.	210	488	.	488	0.19
1984	1884	502	.	502	23	.	23	525	.	525	0.28
1985	1905	373	.	373	*	7	7	373	7	380	0.20
1986	2344	341	.	341	*	37	37	341	37	378	0.16
1987	1276	230	.	230	*	15	15	230	15	245	0.19
1988	1528	290	.	290	*	9	9	290	9	299	0.20
1989	971	116	.	116	*	11	11	116	11	127	0.13
1990	1182	232	.	232	*	22	22	232	22	254	0.21
1991	818	176	.	176	*	10	10	176	10	186	0.23
1992	1552	386	24	410	*	75	75	386	99	485	0.31
1993	1284	225	0	225	*	18	18	225	18	243	0.19
1994	1051	160	88	248	*	38	38	160	126	286	0.27
1995	719	73	38	111	*	23	23	73	61	134	0.19
1996**		5	926	931	*	168	168	5	1094	1099	
1997**		3	571	574	*	184	184	3	755	758	
1998**		4	468	472	*	114	114	4	582	586	
1999**		2	434	436	*	41	41	2	475	477	
2000**		98	341	439	*	55	55	98	396	494	
84-89 $\bar{X}$	1651.3	308.7	.	308.7	.	15.8	17.0	312.5	15.8	325.7	0.20
95% CL	517.9	137.8	.	137.8	.	15.2	11.9	145.1	15.2	142.5	0.05
N	6	6	0	6	0	5	6	6	5	6	6
86-91 $\bar{X}$	1353.2	230.8	.	230.8	.	17.3	17.3	230.8	17.3	248.2	0.18
95% CL	571.1	83.7	.	83.7	.	11.3	11.3	83.7	11.3	91.5	0.03
N	6	6	0	6	0	6	6	6	6	6	6
92-95 $\bar{X}$	1151.5	211.0	37.5	248.5	.	38.5	38.5	211.0	76.0	287.0	0.25
95% CL	562.6	210.4	59.1	196.0	.	41.0	41.0	210.4	74.7	233.4	0.11
N	4	4	4	4	0	4	4	4	4	4	4
96-99 $\bar{X}$			599.8	603.3	.	126.8	126.8		726.5	730.0	
95% CL			358.2	359.9	.	102.7	102.7		430.8	432.5	
N			4	4	0	4	4		4	4	

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1985-1995 AND ON RETAINED FISH ONLY PRIOR TO 1985.

* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.

**DATA OBTAINED FROM THE LICENSE STUB RETURN; 2000 DATA ARE PRELIMINARY

1996-1999 CATCH AND RELEASE ONLY. YEAR 2000 - TWO WEEK RETENTION, OTHERWISE CATCH AND RFELEASE ONLY

Appendix 4. Angling catch statistics for Fischells Brook. Data for 1974-1995 were collected by DFO River Guardians, data for 1996-2000 are from the license stub return. 2000 data are preliminary.

River: Fischells Brook — Code: 4000960

Year	Effort Rod Days	Small (<63 cm) Ret.	Rel.	Tot.	Large (>=63 cm) Ret.	Rel.	Tot.	Total (Small + Large) Ret.	Rel.	Tot.	CPUE
1974	753	220	.	220	27	.	27	247	.	247	0.33
1975	522	184	.	184	21	.	21	205	.	205	0.39
1976	418	185	.	185	16	.	16	201	.	201	0.48
1977	468	245	.	245	66	.	66	311	.	311	0.66
1978	292	154	.	154	31	.	31	185	.	185	0.63
1979	168	67	.	67	0	.	0	67	.	67	0.40
1980	386	227	.	227	40	.	40	267	.	267	0.69
1981	463	272	.	272	11	.	11	283	.	283	0.61
1982	651	357	.	357	7	.	7	364	.	364	0.56
1983	377	128	.	128	7	.	7	135	.	135	0.36
1984	411	214	.	214	8	.	8	222	.	222	0.54
1985	373	145	.	145	*	3	3	145	3	148	0.40
1986	427	184	.	184	*	4	4	184	4	188	0.44
1987	266	59	.	59	*	2	2	59	2	61	0.23
1988	840	374	.	374	*	7	7	374	7	381	0.45
1989	110	17	.	17	*	0	0	17	0	17	0.15
1990	256	116	.	116	*	12	12	116	12	128	0.50
1991	414	157	.	157	*	16	16	157	16	173	0.42
1992	384	133	8	141	*	11	11	133	19	152	0.40
1993	819	157	0	157	*	34	34	157	34	191	0.23
1994	702	216	58	274	*	47	47	216	105	321	0.46
1995	555	80	112	192	*	43	43	80	155	235	0.42
1996**		315	232	547	*	150	150	315	382	697	
1997**		182	162	344	*	127	127	182	289	471	
1998**		17	36	53	*	4	4	17	40	57	
1999**		.	.	.	*	.	.	.	.	.	
2000**		.	.	.	*	.	.	.	.	.	
84-89 $\bar{X}$	404.5	165.5	.	165.5	.	3.2	4.0	166.8	3.2	169.5	0.42
95% CL	255.9	132.8	.	132.8	.	3.2	3.2	133.4	3.2	135.5	0.10
N	6	6	0	6	0	5	6	6	5	6	6
86-91 $\bar{X}$	385.5	151.2	.	151.2	.	6.8	6.8	151.2	6.8	158.0	0.41
95% CL	263.9	131.5	.	131.5	.	6.5	6.5	131.5	6.5	133.6	0.09
N	6	6	0	6	0	6	6	6	6	6	6
92-95 $\bar{X}$	615.0	146.5	44.5	191.0	.	33.8	33.8	146.5	78.3	224.8	0.37
95% CL	299.3	89.7	82.4	94.3	.	25.6	25.6	89.7	100.9	115.5	0.20
N	4	4	4	4	0	4	4	4	4	4	4
96-98 $\bar{X}$		171.3	143.3	314.7	.	93.7	93.7	171.3	237.0	408.3	
95% CL		370.9	246.8	616.9	.	195.0	195.0	370.9	439.3	806.3	
N		3	3	3	0	3	3	3	3	3	

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1985-1995 AND ON RETAINED FISH ONLY PRIOR TO 1985.

* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.

**DATA OBTAINED FROM THE LICENSE STUB RETURN.

1998 CATCH AND RELEASE ONLY; RIVER CLOSED TO ANGLING IN 1999 AND 2000

Appendix 5. Angling catch statistics for Flat Bay Brook. Data for 1974-1994 were collected by DFO River Guardians. During 1995 and 1996 this river was closed to angling. Data for 1997-2000 are from the license stub return. 2000 data are preliminary.

River: Flat Bay Brook — Code: 4101080

	Effort	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			
Year	Rod Days	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	CPUE
1974	2156	510	.	510	59	.	59	569	.	569	0.26
1975	2625	408	.	408	42	.	42	450	.	450	0.17
1976	1705	609	.	609	48	.	48	657	.	657	0.39
1977	1045	209	.	209	26	.	26	235	.	235	0.22
1978	537	140	.	140	12	.	12	152	.	152	0.28
1979	263	72	.	72	4	.	4	76	.	76	0.29
1980	932	445	.	445	26	.	26	471	.	471	0.51
1981	1299	457	.	457	39	.	39	496	.	496	0.38
1982	1357	427	.	427	33	.	33	460	.	460	0.34
1983	1123	308	.	308	7	.	7	315	.	315	0.28
1984	602	325	.	325	7	.	7	332	.	332	0.55
1985	1060	303	.	303	*	6	6	303	6	309	0.29
1986	684	174	.	174	*	2	2	174	2	176	0.26
1987	816	219	.	219	*	0	0	219	0	219	0.27
1988	871	249	.	249	*	5	5	249	5	254	0.29
1989	612	130	.	130	*	1	1	130	1	131	0.21
1990	939	277	.	277	*	6	6	277	6	283	0.30
1991	977	251	.	251	*	2	2	251	2	253	0.26
1992	666	211	12	223	*	20	20	211	32	243	0.36
1993	678	173	0	173	*	17	17	173	17	190	0.28
1994	615	128	8	136	*	32	32	128	40	168	0.27
1995	.	.	.	.	*	.	.	.	.	.	.
1996	.	.	.	.	*	.	.	.	.	.	.
1997**		-	253	253	*	57	57	-	310	310	
1998**		-	131	131	*	89	89	-	220	220	
1999**		-	264	264	*	37	37	-	301	301	
2000**		130	442	572	*	112	112	130	554	684	
84-89 $\bar{X}$	774.2	233.3	.	233.3	.	2.8	3.5	234.5	2.8	236.8	0.31
95% CL	185.9	78.4	.	78.4	.	3.2	3.0	80.3	3.2	81.0	0.10
N	6	6	0	6	0	5	6	6	5	6	6
86-91 $\bar{X}$	816.5	216.7	.	216.7	.	13.0	2.7	216.7	16.3	219.3	0.27
95% CL	150.7	57.9	.	57.9	.	12.8	2.5	57.9	17.3	59.5	0.03
N	6	6	0	6	0	6	6	6	6	6	6
92-96 $\bar{X}$	653.0	170.7	6.7	177.3	.	23.0	23.0	170.7	29.7	200.3	0.31
95% CL	83.1	103.2	15.2	108.5	.	19.7	19.7	103.2	29.0	95.8	0.13
N	3	3	3	3	0	3	3	3	3	3	3
97-99 $\bar{X}$			216.0	216.0	.	61.0	61.0		277.0	277.0	
95% CL			183.4	183.4	.	65.2	65.2		123.1	123.1	
N			3	3	0	3	3		3	3	

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1985-1996 AND ON RETAINED FISH ONLY PRIOR TO 1985.

* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.

**DATA OBTAINED FROM THE LICENSE STUB RETURN; 2000 DATA ARE PRELIMINARY

1995-1996 RIVER CLOSED TO ANGLING. 1997-1999 CATCH AND RELEASE ONLY.

IN 2000, TWO WEEK RETENTION PERIOD, OTHERWISE CATCHA ND RELEASE ONLY

Appendix 6. Rationale for choosing the factors that were used to adjust the numbers of salmon counted in the snorkelling survey, 2000, to account for the salmon that were not observed.

Crabbes River:

Section 1: Adjustment Factor - 1.15
No salmon were observed in two pools that were too deep to see the bottom. Hence, some salmon may have been missed. One pool was too wide for the two snorkellers to get a complete count. Salmon were seen in six pools; however, 94% of the salmon observed were in two pools. Since this Section received good coverage, except for two pools, and there was only one salmon observed within 1 km of each of the two deep pools an adjustment factor of 1.15 was assumed.

Section 2A: Adjustment Factor - 1.05
There was a complete coverage of Section 2A upstream of the gorge. All salmon, except one, were observed in one pool. Visibility was excellent (10 m). There was complete coverage except for a small tributary.

Gorge: Adjustment Factor - 1.00
The gorge was completely surveyed by 2 snorkellers. Visibility was good and the bottom could be seen in all pools. No salmon were seen.

Section 2B: Adjustment Factor - 1.15
Visibility was excellent (10 m), and there was complete coverage of the main stem. There is one relatively large tributary of which only the lower 0.5 km was surveyed and only one salmon was observed. Water level was low. Ninety-seven percent of the salmon counted in the section were in two pools.

Section 3: Adjustment factor - 1.15
Visibility was excellent (7 m), and there was complete coverage of the main stem. Sixty-eight percent of the salmon were in one pool. Although coverage was considered complete, three pools were more than 20 m wide.

Section 4: Adjustment factor - 1.10
There was complete coverage of all pools. Pools were all <2 m in depth.

Section 5: Adjustment factor - 1.10
Complete coverage. The two large pools were redone with 13 divers (visibility 6 m). Ninety-seven percent of fish were in one pool. There may be some salmon in tributaries.

Middle Barachois Brook:

Section 1: Adjustment Factor - 1.05
All pools were shallow and there were sufficient snorkellers to survey the entire width of all pools. Good visibility. Snorkellers felt that there were complete counts in all pools.

Section 2: **Adjustment Factor - 1.10**
Complete counts were made in all pools. Visibility was very good, approximately 7 m. Sands Pool is difficult to survey due to its depth and configuration. Three pools were 5 m to 7 m in depth. There may be some salmon in tributaries.

Section 3: **Adjustment factor - 1.10**
Large number of salmon in two pools (163 salmon in one pool and 280 salmon in another). Visibility was very good > 7 m. Complete counts/estimates in all pools. There may be some salmon in tributaries.

Section 4: **Adjustment factor - 1.00**
No salmon observed. All pools were surveyed. Visibility > 7 m.

Robinsons River:

Section 1, Pool at base of falls: **Adjustment Factor - 1.30**
The large pool at the base of falls was surveyed with 10 snorkellers using a rope across river with a 4 m rope hanging down every 2.5 m. Salmon appear to herd to the downstream end of pool. Survey considered incomplete. Impossible to see bottom in most of pool.

Section 1, Remainder of Section: **Adjustment Factor - 1.05**
There was only one out of 11 pools where the survey was considered partial. Visibility was good and there were sufficient snorkellers to cover width of river.

Section 2: **Adjustment Factor - 1.20**
Surveyors considered counts to be complete in all pools. About 85% of salmon were in one pool. Pools were all 2 m or less in depth and the bottom could be seen in all of them. Visibility reduced due to large number of boulders and suspended material in water (after rain). Some fish were in "runs" where water velocity was relatively high.

Section 3: **Adjustment factor – 2.00**
Salmon were mostly observed in runs. Visibility was poor (1.5 m) due to sediment after rain and velocity was relatively high. There was only one pool in Section 3, which was at the confluence of Big Dribble Brook.

Section 4: **Adjustment factor - 1.30**
Counts were considered incomplete in three of 13 pools because water was too deep to see bottom. Visibility was only fair (3 m).

Northern Feeder: Not surveyed.

Fischells Brook:

Section 1: Adjustment Factor - 1.15
The water was too deep to get a complete count of salmon in one pool. Salmon were only observed in three pools. Water dark and visibility reduced to about 2 m. All except one salmon found in two pools. Helicopter was used to transport crew between pools. Most pools were shallow.

Section 2: Adjustment Factor - 1.15
Complete counts made in 11 of 12 pools. All pools, except one were 2 m or less in depth and the bottom could be seen in all of them. One pool was too deep to see bottom; therefore the count was incomplete. Over 200 salmon were counted in each of 3 pools. Visibility was 3 m.

Section 3 (Steadies): Adjustment factor - 1.15
Some fish may have been missed when occasionally snorkellers had to stand up when assistants had difficulty keeping the rope in a straight line. Snorkellers were in the water for 3 hours and may have occasionally lost concentration.

Section 4: Adjustment factor – 1.15
Many salmon were seen in runs where there were large boulders, which enhanced the chances of fish not being observed. There were two pools in which surveyors felt that they may have missed some salmon.

Section 4: Adjustment factor – 1.15
Two pools in this Section were too deep to see bottom. No salmon were seen in one of these pools and only one in the other. However, snorkellers felt that it was unlikely that very many salmon were missed.

Flat Bay Brook:

Section 1 & 2: Adjustment Factor
These sections were not surveyed in 2000 due to high water levels. The numbers of large and small salmon were estimated by assuming that the percentage of the total number of salmon in the Brook that was in Sections 1 & 2 in year 2000 was equivalent to the average percentage in these Sections in 1998 and 1999 (calculated from data in Porter 1999, and Porter 2000a). Thus in 2000, it is estimated that 23.8 % of the small and 21.5% of the large salmon in Flat Bay Brook were in Sections 1 & 2.

Section 3: Adjustment Factor - 1.15
This Section is short, and most of the salmon were in three pools. Only one pool had an incomplete count.

Section 4: Adjustment factor - 1.30
Thirteen snorkellers were used. Water level was higher than 1999 (water level a bit too high for a good survey) and visibility was reduced to about 3 m or less in areas where snorkellers disturbed substrate while walking. Two pools, which had large numbers of salmon, were too wide and/or too deep to get a complete count. The steadies are long and the snorkellers had to stay in the water for extended periods of time (> 1 hour); thus it was difficult for surveyors to maintain visual attention for entire duration, which may have resulted in some fish being missed.

Section 5: Adjustment factor – 2.00
Nine snorkellers were used. Water level velocity fast and visibility was about 3 m. Two pools were too deep to see bottom. Most of the salmon were in runs and frequently among large boulders; hence, and it is likely that some fish were undetected.

Appendix 7. Results of test to assess snorkeller biases in sizing and counting salmon. There were 35 model salmon, of which nine were large (> 63 cm) and 26 were small (<63 cm) salmon.

a) Results of first count by snorkelers

Snorkeler	Large Salmon		Small Salmon		Total	
	# Counted	% Diff from actual #	# Counted	% Diff from actual	# counted	% Diff from actual
1	6	-33.3	25	-3.8	31	-11.4
2	3	-66.7	31	19.2	34	-2.9
3	8	-11.1	24	-7.7	32	-8.6
4	10	11.1	21	-19.2	31	-11.4
5	3	-66.7	17	-34.6	20	-42.9
6	4	-55.6	29	11.5	33	-5.7
7	9	0.0	26	0.0	35	0.0
8	9	0.0	25	-3.8	34	-2.9
9	9	0.0	26	0.0	35	0.0
10	8	-11.1	23	-11.5	31	-11.4
11	8	-11.1	19	-26.9	27	-22.9
Total	77	-22.2	266	-7.0	343	-10.9

b) Average of two counts of large and small salmon conducted by snorkellers as indicated. Other snorkellers only counted the model fish once.

Snorkeler	Large Salmon		Small Salmon		Total	
	# Counted	% Diff from actual #	# Counted	% Diff from actual	# counted	% Diff from actual
1*	6	-33.3	25	-3.8	31	-11.4
2*	4	-55.6	31	19.2	35	0.0
3*	7	-22.2	26	0.0	33	-5.7
4*	10	11.1	22	-15.4	32	-8.6
5*	4	-55.6	23	-11.5	27	-22.9
6*	4	-55.6	29	11.5	33	-5.7
7	9	0.0	26	0.0	35	0.0
8	9	0.0	25	-3.8	34	-2.9
9	9	0.0	26	0.0	35	0.0
10	8	-11.1	23	-11.5	31	-11.4
11*	8	-11.1	22	-15.4	30	-14.3
Total	78	-21.2	278	-2.8	356	-7.5

* snorkellers who counted salmon twice